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REVIEWS AND NOTES.

Introduction to Mathematical Statistics. By Carl J. West, Ph.D. Columbus, Ohio: R. G. Adams and Co., 1918. Pp. 144.

This book affords a mixed feeling of delight and disappointment.

According to his preface, the author addresses himself to statisticians who, not being also mathematicians, are unacquainted, or only partly acquainted, with the theory underlying many of the statistical processes used by them, or that might be profitably used if they could do so understandingly. To avoid the limitation that has made the existing treatises on the subject unserviceable to these persons, he aspires to convey the matter in more elementary mathematical media. It is not a handbook on statistics, for it assumes a familiarity with the ordinary statistical methods. Rather, the author seeks, not to "popularize," but to make accessible to larger numbers a knowledge of the science underlying an art that is practiced, in many respects, on the basis merely of authority.

The reviewer's response to the note in this preface was instant and exultant, for he is himself one of the large class addressed. He dares to believe, moreover, that this feeling and his subsequent experience with the book were somewhat representative, and therefore ventures to set down, for the sake of the common good, his impressions after reading it.

We are correctly described by the author as frequently uninformed on the reasons for our statistical conduct. While we earnestly desire to be instructed, we are handicapped by the limits upon our knowledge of higher mathematics. Perhaps the reviewer's maximum attainment, comprising introductory courses through analytical geometry and calculus, is typical. Perhaps, also, his present vacant memory of the content of those courses, long since completed, in an unpracticed subject is even more typical. The available books that we have boldly opened have proven quite beyond us, except at most in spots, and those near the beginning. We are troubled with the fidelity of their authors to the technical terminology and forms of expression of mathematics. We are suffocated with the mathematical atmosphere. We are exhausted by the mathematical gymnastics they put us through. We are utterly baffled by the long leaps from "since so-and-so is true, it is apparent that such-and-such follows," when it is not only not apparent to us, but not at all fathomable even after hours of soundings with our inadequate plumb line. In a word, our minds are non-mathematical. We may even be called boneheads by the plain spoken. What we need is a presentation of the theory of our art in terms boldly defying the standards of good form for mathematical expression, and without mathematical exercises thrown in for our mental discipline. We would rather read ten pages of utterly naive explanation that instantly carries a point to our undeveloped mathematical comprehension than spend ten times as long on one page of scrupulously scientific and coldly dignified stuff that never touches us. Speaking etymologically, we would like a book that will patiently *instruct* us and not aim to *educate* our mathematical abilities or presuppose any mental agility with the concepts and terminology of higher mathematics.

This, then, is the group that the author has essayed to befriend. It is from their point of view, and not that of a mathematician, that this review is written.

The general plan of the book lends itself to an easily comprehended development. The author begins with the familiar graphical device of a wavy line connecting successive points and gives this a simple mathematical expression as a "curve" located with respect to its axes and amply equipped with definitions. He describes the significance of such a curve and of the area within it, and the theoretical meaning of a smoothed curve. From this the nature of the frequency curve is developed in mathematical terms that facilitate later discussion, and its aptitude for interpreting typical, although incomplete, data is explained. A chapter on averages then describes the mean, both arithmetical and geometric, the median and the mode, and explains the peculiar statistical properties and serviceableness of each. Then follows an analysis of the form of a frequency curve as disclosing the nature of any distribution and the dispersion of the data. Measures of dispersion, their mathematical significance and their comparative virtues are explained. A chapter is given to the normal frequency curve, in which the theory of it is stated and applied in fitting such a curve to given data.

Then follow chapters on the correlation of series of data. In these the author's plan of discussion is most successful in its adaptation to the readers whom he addresses. He avoids the too mathematical terminology and concepts employed in the explanations of the theory of correlation commonly found. He builds onto the concepts of the frequency curve, already made familiar, and develops by simple steps the nature of correlation, the evidences of its existence, and the measure of its degree. The subject is given further special treatment in chapters on correlation from ranks and on the method of contingency.

A chapter on the moments of a distribution explains how the equation may be found for a straight line to fit data susceptible of being so interpreted. In an appendix, the fitting of frequency curves to statistical distributions as developed by Pearson is explained and formulas given for those readers who are more adept in mathematics than the class to which the author mainly addresses himself.

The delightful features of the book lie in the simply planned selections of essential topics and in the evident attempt to develop them in language understandable by ordinary statisticians. With perseverance, the reader of the class addressed will be pleased with the grasp he will get of the theory of statistics as presented in this volume.

But this delight, although great, will be marred by disappointments. In the first place, while well planned, the discussion is not well composed. It is often obscurely phrased. The point of departure is in nearly every case that of the mathematician, discursing on abstract mathematical formulae, rather than that of the concrete statistical setting in which the statistician finds his problem. The attention of a non-mathematical statistician would be far more likely secured, his interest better sustained, and his comprehension facilitated and quickened if the chapters began with a concrete statistical problem for which the theory was then developed as the method of solution. Not only are the mathematical topics introduced without previous reference to their statistical bearing, but they are abruptly introduced. There is want of introductory and transitional passages to hook up the matter under discussion with what had preceded, as well as with concrete settings. The effect is to leave the reader with insufficient perception of what it is all about and how it bears on what he already knows of statistical methods.

The author's expression further misses the mark at times in that, notwithstanding the limitations on his selected group of readers, he too often writes as a mathematician, assuming that terms, condensed or elliptical expressions, and suggested explanations that would be quite obvious to mathematicians will be clear to those whom he addresses. While the statisticians addressed may, indeed, worry out the meaning, they will be irritated, if not discouraged, at having to work out puzzles before they can get at the matter that interests them. The whole book extends to only 144 pages of text. It could well afford to have been doubled in volume in order to include fuller definitions and greater statement of detail.

Another source of confusion is a number of inaccuracies. Many of these are plainly typographical, such as inevitably occur in setting up mathematical copy. Some of these are obvious to any reader. For example the omission of the dollar sign from the mean prices found on page 33; the omission of "q" from "frequency," on page 28; and the transposition of the side and top legends in Table IX, page 69. Another less obvious, and hence more perplexing error is found on page 40, where the paragraph at the middle of the page beginning "The median can," etc., and Exercises 19 and 20 apparently should come at the top of the page. These defects will give readers little or no trouble. But thoughtful proofreading ought not to have permitted such perplexing errors as the following: the substitution of the digit 2 for 5 in the footing of the fourth column on page 50, which does not agree with the totals for the same items as shown on pages 24 and 33; the insertion of the subscript 3 with the parenthetical term near the bottom of page 87; the substitution of the figure 6 for the letter y in the expression for S_3, and the ommission of the subscript 1 from the letter y in the expression for S_5, on page 98; the substitution of the exponent 2 for 3 in the term $\boldsymbol{d}$ in the reduction of moments on page 99; the reference to page 91 instead of 96 for formulas used on page 101; the substitution of the subscript y for x with y in the equation on page 108.

Of like disconcerting effect is occasional looseness, if not inaccuracy, of expression. On page 48, the paragraph defining the mean squared deviation is headed "The Standard Deviation," while the definition of the standard deviation is given on page 51. In the text on page 49 the Greek letter sigma is designated to represent the mean squared deviation, while in the accompanying equation, and in subsequent usage it is designated by the usual sigma squared. On page 83, the mean squared deviation of the regression means is derived and is then divided, according to the text, by the *standard deviation* of all the corresponding array, but according to the equation, by its *mean squared deviation.* At the bottom of page 112, reference is made to the mean standard deviation of certain quantities when the mean squared deviation is meant.

In working out the computations for the formulas at the bottom of page 106, the reviewer has not been able to derive the same solutions as those shown on page 107.

Another apparent inaccuracy is so consistently followed as to leave the reviewer in doubt whether the author has made a mistake or is himself simply dense. In applying the definition, on page 71, of the respective means of the x- and y- arrays to the problem as described on pages 75 and 76, and tabulated on page 77, it has seemed that the x- array has been confused with the y- array. On page 82 the values shown for the standard deviations of x and y seem to be a transposition of the values required by the definitions near the head of the page. This is essentially the same difficulty as that just noted. It is present also in the interpretation of the example on pages 78 and 79, for the reviewer cannot follow the explanation of the second distribution unless he takes for the y's what seems, by definition to be the x's. The probability is against the author repeatedly making the same mistake. But, then, he is guilty of most indefinitive definitions and non-explanatory explanations for the readers he hopes to assist. The reviewer intends, for his own enlightenment, to submit this to someone more qualified than he to pass upon the mathematics of the case. But he here records, as one of the readers addressed, the results which the book itself has produced on this point.

The effect of the author's, at times too condensed expression, at times obscure phraseology, and of the inaccuracies noted and the appearance, if not the fact, of confusion between general theory and specific application is to cover the trail for the ordinary statistical reader in his pursuit of the point of discussion and to compel him to stop and tread around in a disconcerting, and even discouraging, endeavor to find the trail again. He is little, if at all, interested in the making of trails on his own account in this field of exploration, or in cultivating ability do to so. He would like to make use of the road already opened by the Karl Pearsons, so far as he can learn it. But for that purpose, he wants to have the road shown to him and does not desire to reconstruct it.

By way of summary: This book is far more comprehensible to ordinary statisticians than any mathematical statement of statistical theory that the reviewer has seen. Anyone who has had algebra and who has the general notion of mathematical expression can follow most of the matter in the book if his interest in statistical theory is sufficient to withstand the resistance offered and if he has time enough outside of making his living to "plug" at the subject. What is here said in adverse criticism is not to be taken as damning a book that is, in fact, at the head of the list for the purposes for which intended. It is merely to point out to non-mathematical statisticians that this is not *the* book for which they are waiting.

Indeed, the reviewer is inclined to think that that book cannot be written by a mathematician. His habits of thought and expression are against his success. Even if he could overcome that, his professional pride would stand in his way. That book must translate the mathematics of the subject into non-scientific language carrying over as few original expressions as possible. It will be a work, not of scholarship, but of adaptation of expression based on full knowledge of statistical practice. That would bring little credit to the author as a mathematician, and might well commit him to professionally childish work. That book will have to be written by one of the boneheads themselves who, by dint of perseverance, shall have learned the language of mathematics and then, having no mathematical reputation at stake, can dare to write with complete disregard of the highbrow standards of good form in mathematical discussion. His own full knowledge of statistical processes and his fellow feeling for his confrères will induce him to address them understandingly.

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The Mathematical Theory of Population, of Its Character and Fluctuations, and of the Factors which Influence Them. Appendix A. Vol. I. Census of the Commonwealth of Australia. By G. H. Knibbs, C.M.G., F.S.S., F.R.A.S., etc., Commonwealth Statistician. Published under instruction from the Minister of State for Home and Territories, Melbourne, 1917. Pp. iv, 466.

The above monumental work represents a veritable milestone in statistical theory, which is emphasized by the fact that it has received almost universal praise from a number of leading statisticians the world over. Mr. Knibbs, the eminent statistician of the Australian Government, is by no means unknown to students of advanced statistical methods. His previous contributions have never been voluminous verbalisms, a very commendable but unfortunately rare occurrence in statistical literature. What they lack in quantity of paper they make up in originality and scholarship. The former small pamphlets from the hands of Mr. Knibbs have always brought to the present reviewer a very refreshing breeze of stimulating thought and a stream of new and original ideas. They have always been admirable in their brevity and lucid expression and stand in a class by themselves as examples of a clear and lucid exposition of thought.

One would therefore naturally expect something really valuable in this new tome of the Australian statistician. But even our fondest expectations were surpassed by the receipt of this massive volume of more than 460 large octavo pages, which for all times will stand as one of the leading works on mathematical statistics of the twentieth century. Not that the volume affords easy reading—on the contrary, I readily confess that I have not as